Covaris

WCS™ Water Conditioning System

USER MANUAL

A system developed for maintaining bath water quality in Covaris AFA™ instrumentation

Product Name: Water Conditioning System

Product Number: WCS

UNIVERSAL PRECAUTIONS

Universal Precautions should be followed on all specimen samples, regardless of whether a sample is known to contain an infectious agent. Laboratories handling specimen samples are advised to comply with applicable parts of the following governmental and clinical standards, or their equivalent in the country of use:

- Centers for Disease Control (CDC), Universal Precautions for Prevention of Transmission of HIV and Other Bloodborne Infections, published 1987, updated 1996
- Clinical and Laboratory Standards Institute (CLSI), GP17-A2 Clinical Laboratory Safety; Approved Guideline - Second Edition, published 2004, ISBN 1-56238-530-5
- Clinical and Laboratory Standards Institute (CLSI), M29-A3 Protection of Laboratory Workers from Occupationally Acquired Infections; Approved Guideline, Third Edition, published 2005, ISBN 1-56238-5674
- Occupational Safety and Health Administration (OSHA), 29 CFR 1910.1030 Bloodborne Pathogens
- International Standards Organization (ISO) 15190:2003, Medical Laboratories – Requirements for Safety

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May 2011
Products covered by Patent No. US6, 719,449, US6, 948,843, and other pending applications

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Woburn, Massachusetts
01801-1721 USA

Printed in U.S.A.

Warranty

When used in accordance with written instruction and under normal operating conditions, the Covaris instruments are guaranteed to be free of defects in MATERIAL and WORKMANSHIP for one (1) year from the date of original delivery. Any component which proves defective during the stated period will be repaired free of charge or replaced at the sole discretion of Covaris, F.O.B., Woburn, Massachusetts, provided the defective component is returned properly packaged with all transportation charges prepaid. The customer is expected to perform basic diagnostics and component replacement with telephone support from Covaris personnel. If Covaris personnel are required to perform on-site repair, all travel costs are paid by the customer. A limited warranty as specified may apply to certain components of the equipment.

Warranty Exceptions

This warranty is void if failure of the software or hardware has resulted from accidents, abuse, improper maintenance, or repair, or misapplication by the customer. It is also void if damage is caused by any unauthorized attachments or if modifications are made to the equipment. Removing or tampering with the Safety Enclosure will void the warranty, and the customer will assume all liabilities.

This warranty is limited to the original purchaser and is not transferable.

CONTACT COVARIS, INC. SHOULD YOU HAVE ANY QUESTIONS CONCERNING THIS EQUIPMENT.

Warranty Services

The purchased equipment is covered by a twelve (12) month warranty which includes all the service and support necessary so that the customer can operate the equipment successfully. Extended warranties are available at the end of the original 12 month warranty period.

Services included with the original purchase of the system are:

Installation and Training – Setup and installation of the equipment and operator training can be purchased at time of initial acquisition of the equipment. Both will be performed by a qualified Covaris service representative. One half day will be scheduled to perform the installation and on-site training.

- The operators' training will include valuable hands-on time with the equipment.
- Preventative maintenance and troubleshooting tips will also be covered.

Technical Support – On-going assistance with the operation or application of the equipment and/or troubleshooting is provided via:

- Telephone (+1 781 932 3959) during the hours of 9:00am to 4:00pm, Monday through Friday,
    - United States, Eastern Standard Time (EST).
    - Greenwich Mean Time (GMT-05:00)
- E-mail queries to techsupport@covarisinc.com

Parts Replacement – Replacement of parts (excluding consumables) for normal operation of equipment are provided on a priority basis. Shipping charges are included. Failure due to accident, abuse, or improper operation is not covered.

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1.0 INTRODUCTION

1.1 Overview of the Manual

This manual contains operation and service instructions for the *Covaris WCS™ Water Conditioning System.* It contains background information essential to the proper use and care of this equipment.

Should any unforeseen problems occur with the normal operation of the equipment, contact Covaris Technical Support immediately.

The following definitions apply in this manual:

NOTE:	Inconvenience if disregarded.

CAUTION:	Equipment damage may occur.

WARNING:	**Personal injury may occur.**

1.2 Safety Symbols and Warnings

The following symbols are employed in product labeling and in this manual. Where these relate to safety risks, failure to observe the associated precautions could result in injury to people or damage to property.

This is the general alert symbol. It may be used to alert you to potential safety hazards. Obey all safety messages that follow this symbol.

This symbol is used to identify an ELECTRICAL SHOCK hazard.

This symbol is used to identify an ULTRAVIOLET LIGHT hazard.

This symbol is used to identify a potential BIOLOGICAL hazard.

1.3 For the safety of operating personnel

1. Make sure that the power supply module is properly grounded. Employ a power cable with a grounding prong, plugged to a power receptacle with a grounded receptacle. DO NOT operate the unit if it is not properly grounded.
2. The unit is equipped with a power plug appropriate for the destination country. DO NOT, under any circumstances, remove the grounding prong from the power cord.
3. Always disconnect power to the equipment (unplug) before performing any service or maintenance. Reconnect power only as instructed.
4. Employ only the 12 volt DC power module provided with the unit, or a replacement provided by Covaris.
5. Follow all precautions when changing the UV lamp. Avoid exposure to direct or strongly reflected germicidal ultraviolet rays. Germicidal ultraviolet rays are harmful to the eyes and skin.
6. THE ULTRAVIOLET LAMP CONTAINS MERCURY (Hg). Handle carefully to avoid breaking the lamp. Dispose of used lamps according to disposal laws. For further information, see one of the following websites or contact Covaris.
   www.lamprecycle.org (North America)
   www.lamprecycling.com (North America)
   www.mercuryrecycling.co.uk (UK)
   www.malampe.org (France)
7. If there is a safety related malfunction, DO NOT operate the equipment and contact Covaris immediately.
8. If the equipment is used in a manner not specified by the manufacturer, the protection provided by the equipment may be impaired. Do not remove safety labeling.

1.4 To prevent damage to the equipment:

1. The WCS is designed for indoor use and to operate in typical ambient laboratory conditions e.g., 15 to 32°C (60 to 90°F). DO NOT operate the instrument in a cold room environment. The system is designed to operate with a water bath and re-circulating heater/chiller apparatus to control sample temperature.
2. The WCS is designed for use with chilled or room temperature bath water. Condensation, however, may form on interior surfaces and drip onto the bench top when the WCS is employed to condition chilled bath water.
3. Distilled or de-ionized water should be used to fill the water bath.
4. Do not employ isopropyl alcohol, ammonia-based or abrasive cleaners on the water tank, as these will damage the acrylic surfaces.
5. When bleaching the AFA system, turn off and disconnect the hoses to the WCS. The WCS fittings are not compatible with bleach solutions.
6. The WCS requires periodic filter and UV lamp replacement, as described in this manual.
7. Do not directly handle the UV lamp – only handle it while wearing cotton or laboratory gloves to avoid fingerprints on the lamp glass.

1.5 Acronyms employed in this User Manual

WCS – Water Conditioning System
UV – Ultraviolet
AFA™ – Adaptive Focused Acoustics

1.6 Product Description

The Water Conditioning System (WCS) is an accessory that may be used with any Covaris AFA™ instrument. The WCS automatically circulates water through a particulate filter and ultraviolent (UV) sterilizer to ensure that water remains clean and free of algae growth for up to one month. The system is designed to run continuously, maintaining water quality and relieving the need for daily water changes in Covaris Adaptive Focused Acoustics (AFA™) systems.

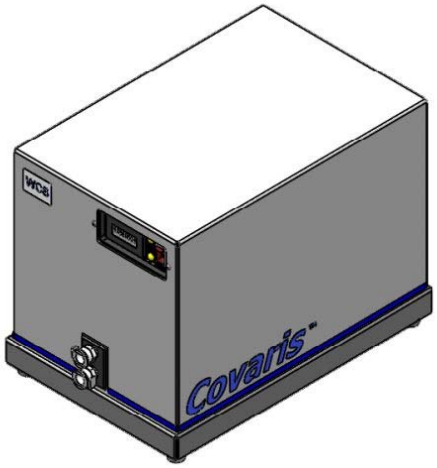

Figure 1 – The Covaris Water Conditioning System

The WCS incorporates an elapsed hours timer and maintenance due indicator for filter and UV lamp replacement after one year of use. Filter and UV lamp replacement may be performed by the user by following instructions included in this manual. In case of a blockage in the system's water flow, a "Check Flow" indicator warns the user that maintenance or service is required. These indicators and the circulation hose hookups are located on the front panel of the system.

The system's power is supplied by a small external converter that operates with any worldwide AC power source (100 to 240 volts AC) and connects to a power jack on the rear panel of the WCS.

The WCS connects via a hose kit to any water bath tank, as depicted in Figures 4 and 5 of this User Manual. The following tanks and hose kits are available for Covaris S and E Series instruments:

For Covaris S Series instruments:

- 500170 Water Tank with Fittings, S Series
- 500173 Hose Kit for S Series

For Covaris E Series instruments:

- 500171 Water Tank with Fittings, E Series
- 500174 Hose Kit for E Series

The following block diagram depicts bath water circulation through the WCS pump, filter and UV lamp system:

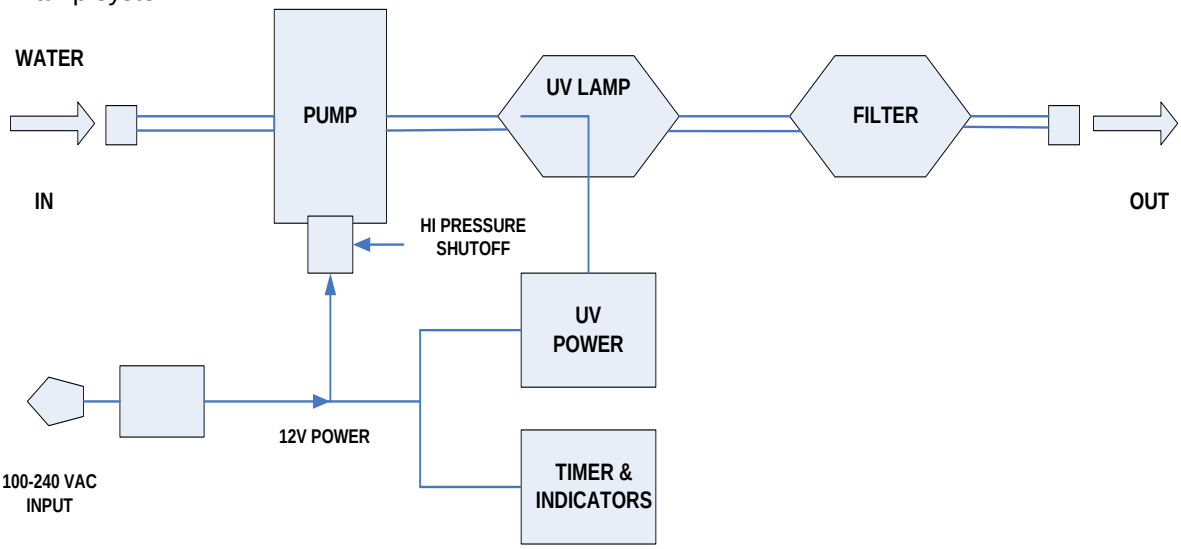

Figure 2 – Water Conditioning System block diagram

The Particulate Filter is rated for 5 micron, so will catch most particulates and many cell types.

The WCS also includes an optional rack for the AFA system laptop computer, allowing the laptop computer to sit above the WCS and save on bench space.

2.0 System Installation and Setup

Unpacking:

- Remove the accessories and cardboard accessory tray.
- Pull the WCS unit out of the box and remove side foam packaging.

The shipping container should contain the following items:

- This User's Manual
- The WCS unit
- 12 volt "universal" input power supply module
- AC power line cord
- UV lamp (packaged separately in a cardboard tube to avoid shipping damage)
- One pair of laboratory gloves
- One laptop computer tray with two thumbscrews and Velcro® disks

Two water circulation hoses with "quick connect" fittings are required to connect the WCS to the water tank. These hoses are provided as part of the tank kit, so are not included in the WCS shipping container.

The WCS unit is approximately 35 cm (14 inches) deep, 24 cm (9.25 inches) wide and 265 cm (10.5 inches) high. Please place the WCS unit on a lab bench or table. Identify the ON/OFF switch, indicators, and hose connect fittings as shown in the following diagram:

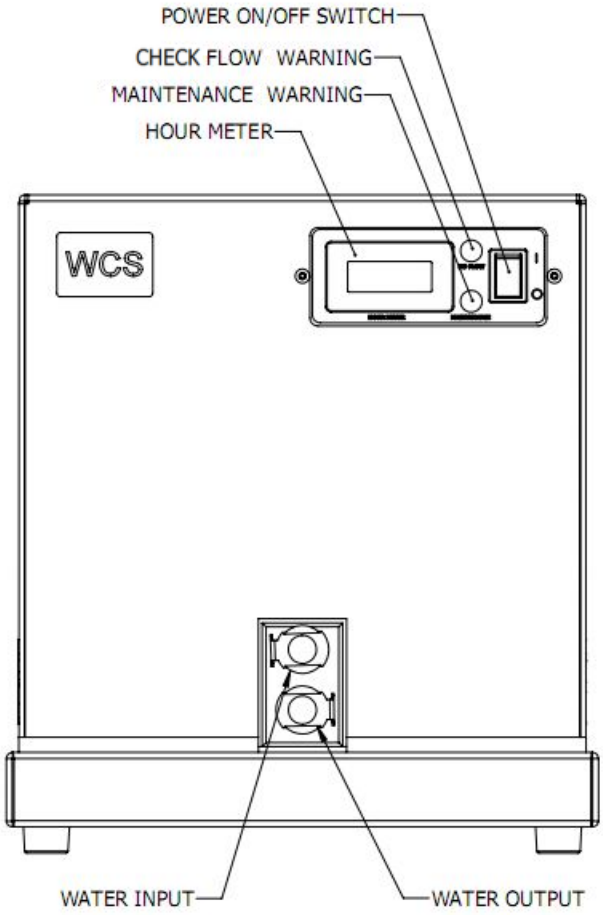

Figure 3 – The WCS front panel

NOTE: The WCS unit is shipped with the UV lamp not installed. Install the UV lamp before powering the unit or using it in any way. See Appendix A for UV lamp installation and replacement instructions.

CAUTION: The WCS is designed to operate with hoses connected to a filled water tank as depicted in the following illustrations. Avoid running the WCS either dry or disconnected from a source of water.

With the lamp is installed and the WCS cover replaced and secured, position the WCS next to the Covaris unit. Connect the water hoses between the WCS and water tank as shown in the following images. Adequate bench space will be needed for the WCS unit as well as the two hoses used to establish water circulation between the AFA bath and the WCS. Please note that the hose fittings are identical: The "input" and "output" hoses may be connected to either position on the water bath tank, but it is recommended for ease of setup to follow the layout depicted in the following figures:

Figure 4 – The WCS connected to a Covaris S System

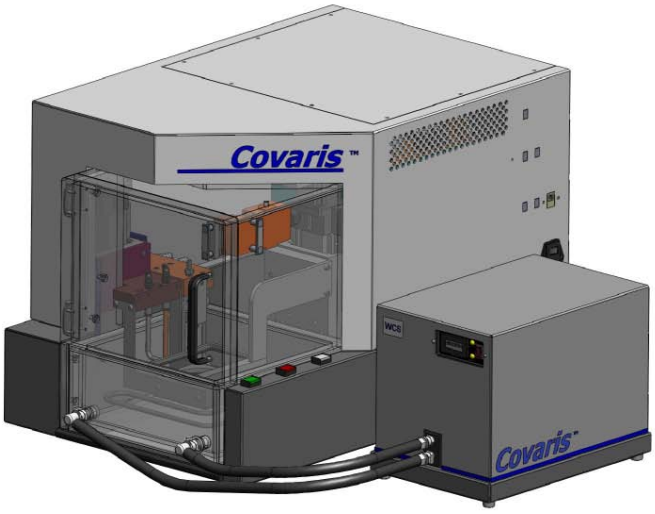

Figure 5 – The WCS Connected to a Covaris E System

For the E System, the WCS typically must be positioned to the right side to avoid interference with the chiller system connections. For the S system, the WCS unit may be positioned to the left or the right.

NOTE: The Quick Connect fittings on the Covaris water bath tank are the same type as those employed for the system chiller. *Do not connect the chiller directly to the tank, or the WCS to the chiller coil inputs.*

With the WCS ON/OFF switch in the OFF position, unpack the power supply and plug it into 12V socket on the rear panel of the WCS unit. Plug the power supply to AC power (100 to 240 volts AC, 50 or 60 Hz).

3.0 Indicators and Controls

There are four operating status indicators on the front panel of the WCS, as shown in the following figure:

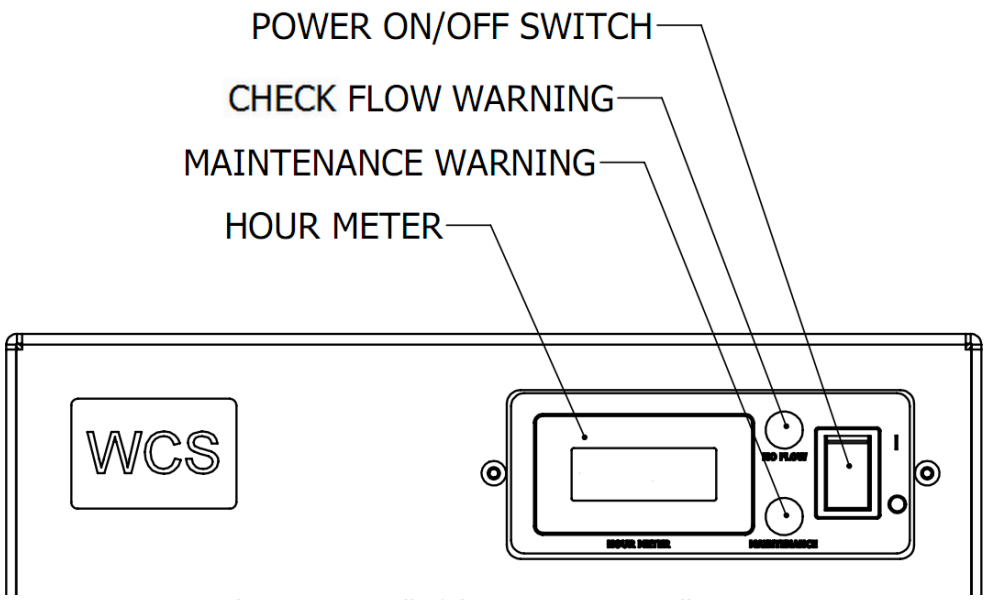

Figure 6 – Detail of the WCS Status Indicators

These indicators operate as described below:

- ON/OFF – When the system is powered ON, the ON/OFF switch is illuminated.
- CHECK FLOW – When illuminated, this indicates that flow through the system has been blocked, causing pump pressure to rise and trip an internal shutoff. Please refer to Appendix B for troubleshooting instructions, or contact Covaris Service.
- HOUR METER – This display shows total elapsed hours of operation in hours and tenths of an hour. When the counter reaches any multiple of 9500.0 hours (approximately 13 months), the MAINTENANCE indicator will illuminate and a CHG lamp icon will appear on the display, indicating that the internal particulate filter and UV lamp should be replaced within 500 hours of additional operation.
- MAINTENANCE – When illuminated, this indicates that the UV lamp and particulate filter should be replaced. The WCS will continue to operate effectively for up to 500 hours after the indicator illuminates, but it is recommended that the UV lamp and filter be replaced as soon as is practical after the MAINTENANCE indicator illuminates. The indicator is shut off by pressing an internal RESET button once replacement is performed. Please see Appendix A for UV lamp and filter replacement instructions. *This indicator will also illuminate if the UV lamp is missing or damaged*.

NOTE: The hour meter displays to 0.1 hour resolution. 500 hours will appear as 500.0 and 5000 hours will appear as 5000.0.

4.0 System Operation

> NOTE: The WCS is designed to operate continuously, except when water is being changed in the AFA system water tank.
>
> To minimize water condensation in a chilled application, the WCS may be employed only when the AFA system is not in use and water is not being chilled. The WCS may also be turned on and off to save power. Frequent power cycling will, however, reduce the life and effectiveness of the UV lamp.

Fill the Covaris system water bath tank with distilled or de-ionized water. Approximately one liter of water will be drawn into the WCS upon first use, so keep extra water on hand.

Turn the WCS ON/OFF switch to the ON position. The switch will illuminate, the hour meter will start and the WCS pump will start to draw water from the water bath. Bubbles will briefly appear in the Covaris System bath as air is purged from the WCS system. Once the air is fully purged from the WCS, add distilled or de-ionized water to the bath tank to restore the water level in the bath.

Please note that a new WCS will have a small number of hours elapsed as part of its initial testing.

The WCS system, when operating, will automatically circulate bath water, filter it and retard the growth of algae or bacteria by irradiation with UV light. It is recommended that the WCS be run continuously for longest UV lamp life and best cleansing effect upon bath water.

When employing the WCS with a Covaris water bath, users may refrain from changing bath water for up to one month. Please note that evaporation will occur, so the bath water level should be verified daily and distilled or de-ionized water added to the bath as needed.

If the WCS is employed with chilled bath water, condensation may form on internal fittings and hoses, causing some water to drip onto the laboratory bench beneath the WCS. This condensation is normal and should abate when the WCS is turned off or the bath water is not chilled. The WCS may be placed on an absorbing mat to contain this condensation. While the recommended mode of operation is continuous, to minimize condensation with chilled bath water, the WCS may be turned off during AFA system operation and run when the Covaris system is not being employed and its chiller is shut off. The filter and UV light sterilization will still greatly retard the growth of algae in the water bath.

Water dripping from the WCS when it is not powered or when employed with room temperature bath water may indicate a leak. The cover may be opened and the fittings examined to determine the source. (See Appendix A for instructions on opening and closing the WCS. See Appendix B for troubleshooting instructions).

Please note that the WCS will only filter and treat the bath water with disinfecting UV radiation. The WCS **does not**:

- Make up for evaporated water
- Chill the water
- Degas the water

Bath water temperature should be controlled with a chiller system via the chiller coil of the Covaris system and the water should be degassed by running the Covaris system degas pump.

Please note that the addition of the WCS to your AFA system will cause a small rise in bath temperature. Lowering the chiller set point by an equivalent amount will restore the desired water bath temperature.

5.0 Optional Laptop Computer Tray

The WCS is delivered with an optional Laptop Computer Tray, which can be attached to the top surface of the WCS to hold the Covaris System laptop and minimize use of laboratory bench space.

Figure 7 – Top and Rear View - Laptop Tray attached to the WCS

To install the laptop tray, simply place the tray on top of the WCS cabinet as shown in Figure 7. Align the mounting holes with the two threaded receptacles in the upper corners of the WCS rear panel. Insert the two thumbscrews into the threaded receptacles and tighten by hand. The system laptop may now be placed on top of the tray and secured with Velcro® disks to minimize use of laboratory bench space.

To secure the laptop, peel the adhesive protector from several of the Velcro® disks and stick the disks to available surfaces on the bottom of the laptop (away from battery packs or other controls). Attach the mating Velcro® disks, remove their adhesive protector and press the laptop into place on the tray. The laptop will be secure, but can be removed at any time.

6.0 Cleaning

The outside surfaces and switch panel can be cleaned with a water-dampened cloth and mild detergent.

> NOTE: When bleaching the AFA System, turn the WCS OFF and disconnect the circulating hoses to the WCS. The filter and fittings of the WCS are not compatible with dilute bleach.

Submersion or excess liquid in the electronics cabinet may harm the electronics and subsequent problems will not be covered under warranty. Do not use abrasives or solvents.

7.0 Specifications

Model	WCS
Power Requirements:	100 – 240 VAC, 50-60 Hz, 1.0 A
Dimensions	35 cm (14 inches) deep, 24 cm (9.25 inches) wide and 265 cm (10.5 inches) high.
Weight	Approximately 7.3 kilograms (16 lbs)
Safety	Certified compliant to Low Voltage Directive 2006/95/EC, EN/UL/CSA 61010-1 “Safety Requirements for Electrical Equipment for Measurement, Control and Laboratory Use, Part 1: General Requirements
EMC	Complies with emissions and immunity standards per EMC Directive 2004/108/EC, EN 61236-1, FCC Part 15, and ICES-003 for Class A equipment.

8.0 Service

The UV lamp and particulate filter are designed for replacement by the user following a MAINTENANCE warning indication on the WCS front panel.

There are no other user-serviceable repairs. Please contact Covaris or your local Covaris representative for assistance.

Please direct any queries to:

Tel: +1 781-932-3959
Fax: +1 781-932-8705
Email: info@covarisinc.com
To place orders: CustomerService@covarisinc.com

Shipping to Covaris, please employ the following address:

Covaris, Inc.
14 Gill Street, Unit H
Woburn, Massachusetts
01801-1721
USA

CAUTION - PREPARING THE WCS FOR SHIPMENT:

PURGE THE WCS OF WATER AND REMOVE THE UV LAMP

Please purge the WCS of standing water prior to return shipment, particularly in cold weather, to prevent freezing damage.

To purge water from the system, turn the WCS completely over (so the unit is upside-down). Connect the hoses to an *empty* tank and turn the WCS power on. Running the unit for about two minutes into an empty tank will remove approximately 750 ml of water from the WCS and prevent damage during shipment due to freezing water.

Tip the tank while it fills so that only air is being drawn into the WCS. Stop the unit and disconnect the hoses when purging is complete.

Please also remove the UV lamp prior to shipment. The UV lamp is fragile and may break if shipped inside the WCS. If returning the lamp with the WCS, please package the lamp separately, ideally in its original shipping tube, or inside a stiff tube or box with adequate packing material to prevent impact and breakage.

See Appendix A for instructions on removing the UV lamp.

Appendix A – Periodic Maintenance

The WCS incorporates an elapsed operating hour meter. When this meter reached 9500 (approximately 13 months of elapsed operation), the MAINTENANCE indicator will illuminate. The WCS will continue to operate effectively for up to 500 hours following this indication, but it is recommended that the UV lamp and filter be replaced as soon as is practical after the MAINTENANCE indicator illuminates. Once these items have been replaced, the maintenance alert should be reset using an internal RESET button.

Replacement accessories are available from Covaris using the following part numbers:

- 500175 - Replacement Water Filter
- 500176 - Replacement UV lamp
- 500170 – S Series tank with Quick Connect fittings for use with the WCS
- 500171 – E Series tank with Quick Connect fittings for use with the WCS
- 500173 – Replacement circulating hose set for S Series
- 500174 – Replacement circulating hose set for E Series

Ultraviolet (UV) Lamp Installation or Replacement

WARNING: Disconnect power to the WCS before changing the UV lamp and follow the lamp replacement instructions. Exposure to UV light is hazardous to exposed skin and eyesight.

1. Turn the WCS power OFF and disconnect the 12V power pack from the rear panel of the WCS unit. Disconnect the two circulation hoses from the front of the WCS.
2. Remove 5 knurled head screws on the rear cover of the WCS. Remove the optional laptop tray if it is being employed.
3. Remove 2 knurled head screws on the front of unit located on each side of indicator panel.
4. Carefully remove the outside cover of the WCS by pulling it up and off the WCS chassis.
5. Identify the UV lamp enclosure and the silver cap on the forward end of the tube – the cap is marked with the words “PULL OFF” and it has a cable exiting from its center.

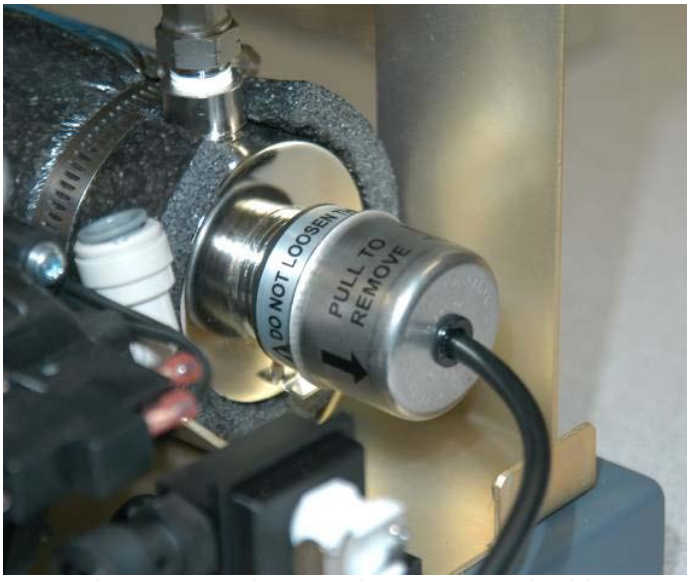

Figure 8 – UV lamp enclosure cap and cable

6. Remove the cap on the UV filter tube by pulling it off the end of the UV lamp enclosure. Gently pull on the cable to withdraw the lamp socket from the enclosure.
7. If a lamp is already installed in the enclosure, it will be drawn out with the socket. Gently disconnect the socket from the lamp and pull the lamp from the enclosure. THE ULTRAVIOLET LAMP CONTAINS MERCURY (Hg). Handle carefully to avoid breaking the lamp. Dispose of used lamps according to disposal laws. For further information, see one of the following websites or contact Covaris.
   www.lamprecycle.org (North America)
   www.lamprecycling.com (North America)
   www.mercuryrecycling.co.uk (UK)
   www.malampe.org (France)
8. While wearing cotton or laboratory gloves (to avoid getting fingerprints on the UV lamp glass), open the round cardboard cylinder (marked LAMP), remove the foam spacer and carefully remove the glass UV tube.
9. Plug the UV tube into the lamp socket (The orientation of the bulb is not important).

Figure 9 - UV plug and lamp

10. Slide the UV tube into the lamp housing and replace the silver cap. Ensure that the silver cap is seated as originally shown in Figure 8.

Particulate Filter Replacement

WARNING: If the Covaris system has been employed for processing of infectious or hazardous biological samples, laboratory gloves should be worn and the used filter cartridge treated as biohazard waste, in case any biological sample accidentally entered the bath and was captured by the filter system.

WARNING: Disconnect the WCS from power and disconnect the two circulation hoses from the front of the unit before changing the lamp or filter.

11. Note the orientation of the tubes and filter cartridge on the left side of the open WCS cabinet. The flow arrows should point towards the front of the WCS cabinet as shown in Figure 10.

Figure 10 – Filter cartridge orientation

12. Position a paper towel under the front Quick Connect fitting on the filter cartridge. Push the locking tab sideways to release the fitting. See Figure 11 below.

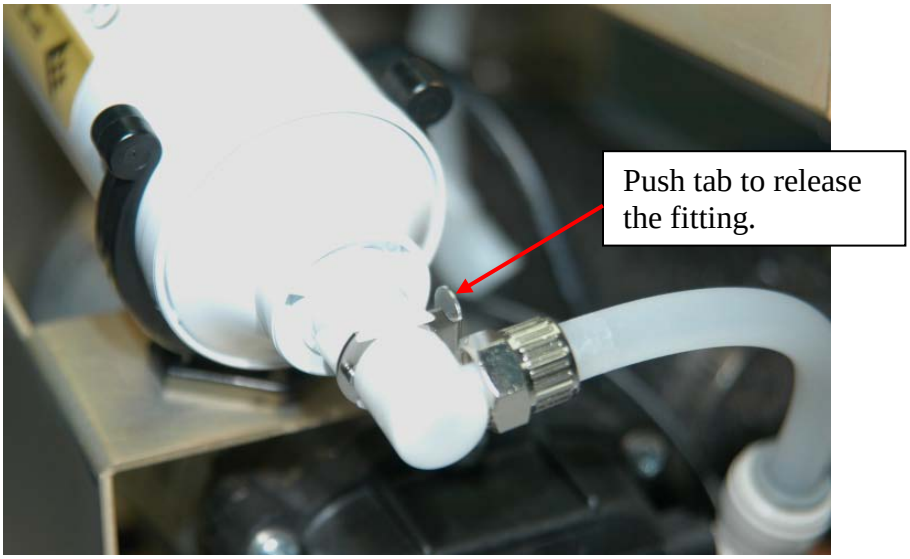

Figure 11 - Quick Connect Fitting

13. While holding the WCS cabinet down, pull on the used filter cartridge to remove it from the plastic grips. The tubing to the upper fitting is sufficiently long that the filter can be lifted partially away from the chassis.
14. Press the locking tab to the side to release the fitting. The quick release fittings will seal and prevent water from draining from the cartridge or tubing.
15. Install the replacement filter by pressing it down into the plastic grips, taking care that the flow arrows point towards the rear panel of the WCS cabinet. Reconnect the fittings as originally found by pressing them into each Quick Connect socket until they snap securely.

WARNING: Moderate pinch hazard - Do not place your fingers under the filter cartridge near the retaining clips while pressing the cartridge into place.

Inspect and Prepare the WCS for Use

16. With the WCS cover off, verify that the UV lamp enclosure is fully closed (the silver cover replaced and the UV lamp is not visible). Fill the Covaris bath with distilled or de-ionized water, and reconnect the 12V power module. Turn the WCS ON.
17. Verify that bubbles briefly appear in the bath as air is purged from the WCS filter. Inspect fittings to ensure there are no water leaks.
18. Once the system is verified to be operating correctly, press the RESET button located above the UV lamp enclosure (See Figure 12). This action turns the MAINTENANCE indicator off. (It will turn on again at the next multiple of 9500 hours.) Verify that the MAINTENANCE indicator turns off and remains off.

Figure 12 – MAINTENANCE RESET button

NOTE: The MAINTENANCE indicator will remain illuminated if the UV lamp has not been correctly plugged in or is not operating.

19. Turn power OFF and disconnect the 12V power module.
20. Replace the WCS cover. Reinstall 5 knurled head screws in the rear of the cover, and reinstall the 2 screws on either side of the front panel display. Hand-tighten to secure each screw. Re-install the laptop tray if this is being used.
21. Reconnect the 12V power module. Restart the WCS. Add water as necessary to the water bath.

Appendix B – User Guidelines and Troubleshooting

- Use only DI or distilled water in the acoustic bath.
- Daily water change is not required - the water is sterilized and filtered by the WCS.
- Check and top-off the water level prior to daily use, to make up for evaporation.
- Bleach the degas pump lines and bath monthly to remove any hidden algae colonies – even with the WCS operating, some colonies may take hold in tubing or crevasses.
- When the WCS is running, set the chiller set point 4 to 5 degrees below the desired bath temperature. The WCS adds some by-product heat to the bath water so the chiller must be set lower to compensate.
- Energy Saver option: Run the WCS only when the AFA instrument and chiller are not in use. Turn the WCS *off* when the instrument is in use, allowing the chiller to be set only 2 to 3 degrees below the desired bath temperature. It is important, however, to switch the WCS back on and switch the chiller off when the system is not in active use.
- If the chiller and WCS must operate together, and the chiller set point must be below 2°C to achieve a low desired bath temperature, water may freeze in the chiller. Using a solution of approximately 20% ethylene or propylene glycol anti-freeze in the chiller will reduce the freezing point to approximately -7°C and remove this risk. Please note – do not employ any anti-freeze solutions in the acoustic bath water. Do not employ automotive anti-freeze in the chiller, as the additives in this product may foul the interior of the heat exchanger and reduce chiller effectiveness.

Problem	Possible Cause	Recommendation
CHECK FLOW indicator illuminates or blinks	Particulate filter is clogged. WCS outlet hose not connected	Replace filter, restart WCS. Connect WCS outlet hose to AFA instrument water tank
Water is dripping onto the laboratory bench	Condensation from circulation of chilled water, leaks from a hose fitting	If conditioning chilled water, change to room temperature water to test if dripping stops. If not, open unit and visually check fittings
No operation, no power	No +12V supply to the WCS	Verify that power pack is plugged into AC wall power and connected to the 12V jack on the rear panel of the WCS
MAINTENANCE indicator is illuminated, and CHG lamp icon is blinking	More than 9500 hours have elapsed since last filter and UV lamp replacement	See Appendix A for filter and lamp replacement instructions
MAINTENANCE indicator is illuminated, no CHG lamp icon	UV lamp is not installed or is damaged.	See Appendix A for lamp replacement instructions

Appendix C – Bio-safety References

1. Centers for Disease Control (CDC), Universal Precautions for Prevention of Transmission of HIV and Other Bloodborne Infections, published 1987, updated 1996
2. Clinical and Laboratory Standards Institute (CLSI), GP17-A2 Clinical Laboratory Safety; Approved Guideline - Second Edition, published 2004, ISBN 1-56238-530-5
3. Clinical and Laboratory Standards Institute (CLSI), M29-A3 Protection of Laboratory Workers from Occupationally Acquired Infections; Approved Guideline, Third Edition, published 2005, ISBN 1-56238-5674
4. Occupational Safety and Health Administration (OSHA), 29 CFR 1910.1030 Bloodborne Pathogens
5. International Standards Organization (ISO) 15190:2003, Medical Laboratories – Requirements for Safety